

1. My name is Shigeyoshi Yoshida. I received a Ph.D. degree in 2002 from Tohoku University located in Sendai Japan.

I am presently employed by NEC-TOKIN Corporation in the position of General Manager of Magnetic Devices Division.

2. This patent application relates to an electromagnetic interference suppressor and in particular to improvement of its thermal conductivity.

Various references have been cited against this patent application. Those references generally relate to magnetic recording materials, and to cores for reactors or transformers. As explained below, the properties of those materials are contrary to the properties required for suppression of electromagnetic interference.

3. It is well-known in the art that ferromagnetic substances are generally classified into two types, that is, a "hard magnetic" one and a "soft magnetic" one depending on the coercive force (Hc) of the substance. The "hard magnetic" substance has a relatively high Hc, whereas the "soft magnetic" substance has a relatively low Hc. The coercive force (Hc) is generally defined as the reverse magnetization force required to bring the magnetization of the substance to zero. On the other hand, a magnetic permeability of the ferromagnetic material is the intensity of the magnetization induced in the ferromagnetic material subjected to an external magnetic field. Accordingly, it is also well known in the art that a ferromagnetic material, which has a high coercive force (Hc), becomes low in the magnetic permeability.

4. It is also well-known in the art that a magnetic recording tape uses a ferromagnetic powder and a binder for adhering the powder particles onto the tape carrier. The

magnetic recording medium requires a hard material (which includes so called semi-hard magnetic material). A magnetic recording is established by applying a magnetic field to the medium. The H_c must be high to prevent erasure or degradation of the recorded information by magnetization from undesired magnetic sources, and B_r must be high to allow playback of the recorded information. This is why soft magnetic materials are never used in the art to record magnetic signals, because they are easily erased.

5. A hard magnetic material cannot be used in an electromagnetic interference (EMI) medium. If the incident EMI wave is too weak to overcome the coercive force (H_c), then the wave passes through the medium and causes EMI. If the incident EMI wave is strong and overcomes the H_c , then the medium records the signal as magnetized patterns, which will magnetically affect to adjacent electronic circuits. The presence of a hard magnetic material in a device will reduce its effectiveness at suppressing EMI and would serve no useful purpose in suppressing EMI.

6. Soft magnetic materials are used in transformer cores, as in the Horie patent cited by the Examiner. In a transformer, current flowing in a primary coil, wrapped around a core, induces a current in a secondary coil, also wrapped around a core. Unlike a magnetic recording medium, the core is designed not to retain energy because that property would reduce the efficiency of the energy transfer from the primary coil to the secondary coil.

7. Because a transformer core should not retain energy, the soft magnetic material must also be low in magnetic losses. As is well-known, a graph of the magnetic induction versus an applied field for a magnetic material provides a hysteresis loop. Hysteresis losses are due to

the dissipation of energy required to move the domain walls back and forth during the magnetization and demagnetization of the magnetic material. In the core of a transformer operating (for example) at 60 cycles/second, the electrical current goes through the entire hysteresis loop 60 times per second, and in each cycle there is some energy lost. So it is desired that the magnetic loss of a soft magnetic material used for a transformer core be as low as possible. The magnetic loss is a component of the permeability (μ) of the material.

8. The soft magnetic material used for a transformer core is not desirable for an EMI suppressing device because of the low magnetic losses. An incident EMI wave on such a soft magnetic material experiences low losses, and so much of the EMI energy passes through the material. For an EMI suppressing device, the magnetic losses must be as high as possible to prevent the EMI energy from passing through the material. Although a transformer core and an EMI suppressor are each made of a soft magnetic material, the losses of the two soft magnetic materials are opposite to each other because of the function each device is to perform.

9. The Hartman patent cited by the Examiner uses particles having ferromagnetic cores made of iron (Example 1) or nickel (Examples 2 and 3). Such materials are hard magnetic materials. This property is beneficial to the Hartman device because the particles are aligned into bridges by the application of an external magnetic field.

10. The Goto patent cited against this application describes a magnetic recording medium. Under the magnetizable recording layer is a second layer that includes a non-magnetic powder. That second layer always includes an electrically conductive material, such as tin

oxide coated onto a pigment, as shown in all of the examples of the Goto patent. An electrically conductive material reflects EMI but can't absorb and the reflection of EMI affects a bad influence to other circuit [can act as a hard magnetic material], and so an electrically conductive material is detrimental to EMI suppression. The non-magnetic powder may include a soft magnetic powder having a high permeability.

11. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name

Shigeoals Yoshida

Date

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